

Chemistry of Life

The One-Look Cheat Sheet

Every concept in Unit 1 — water chemistry, CHNOPS, the four macromolecules, protein folding, and nucleic acids — packed into two dense reference pages built for fast revision before the AP exam.

Water & H-bonding

CHNOPS & Carbon

4 Macromolecules

Proteins & Enzymes

DNA vs RNA

FRQ / CER skills



Water, Elements & Macromolecules

The molecular foundation of Unit 1. Read the master table first, then the supporting concepts. ~8–11% of the exam; the #1 skill is explaining **structure → function**.

THE FOUR MACROMOLECULES — MASTER COMPARISON

CLASS	MONOMER / UNIT	BOND	MAIN FUNCTIONS	EXAMPLES & NOTES
Carbohydrates	Monosaccharides (glucose); C:H:O = 1:2:1	Glycosidic	Quick energy; energy storage; structural support	Glucose; starch (plant storage), glycogen (animal storage); cellulose & chitin (structure)
Lipids	Glycerol + fatty acids — not a true polymer	Ester	Long-term energy; membranes; insulation; signaling	Triglycerides; phospholipids (membranes); steroids (cholesterol, hormones)
Proteins	Amino acids (20)	Peptide	Enzymes; transport; structure; defense; signaling; movement	Amylase, hemoglobin, collagen, antibodies; R-groups set the shape
Nucleic acids	Nucleotides = phosphate + sugar + base	Phosphodiester	Store & transmit genetic information	DNA, RNA

WATER & HYDROGEN BONDING

Root cause: O is more **electronegative** than H → O is partially negative, H partially positive → water is **polar** → molecules form **hydrogen bonds**. Every property below is downstream.

- › **Cohesion** (water–water) → surface tension; unbroken xylem water columns
- › **Adhesion** (water–surface) → capillary action
- › **High specific heat** → buffers temperature of cells, lakes, climate
- › **High heat of vaporization** → evaporative cooling (sweat)
- › **Ice floats** (open lattice, less dense) → insulates lakes
- › **Universal solvent** (polarity) → transport medium

+ Trap

Cohesion = water-to-water; **adhesion** = water-to-other-surface. Capillary action needs both — name both on transport FRQs.

ELEMENTS OF LIFE • CHNOPS

CHNOPS = Carbon, Hydrogen, Nitrogen, Oxygen, Phosphorus, Sulfur.

- › **Carbon:** 4 valence e^- → 4 covalent bonds → chains, rings, branches → molecular diversity
- › **N** → amino groups in proteins; nitrogenous bases
- › **P** → ATP energy transfer; sugar-phosphate backbone; phospholipids
- › **S** → in some amino acids → **disulfide bridges** stabilize folding

MONOMERS, POLYMERS & REACTIONS

Dehydration synthesis (condensation): joins monomers, **removes 1 H₂O** per bond, **needs energy** → builds polymers.

Hydrolysis: **adds 1 H₂O** per bond → breaks polymers into monomers (digestion).

Carbs → glycosidic

Protein → peptide

Lipid → ester

Nucleic → phosphodiester

+ Trap

Building **removes** water; breaking **adds** water. Students reverse this constantly.

CARBOHYDRATES — QUICK FACTS

- › **Monosaccharides:** glucose, fructose (single sugars)
- › **Disaccharides:** sucrose, lactose, maltose
- › **Storage polysaccharides:** starch (plants), glycogen (animals)
- › **Structural:** cellulose (plant walls), chitin (fungi/arthropods)
- › Fast-access energy via glucose pathways

LIPIDS — QUICK FACTS

- › **Saturated:** no C=C, straight tails, pack tight → solid (animal fat)
- › **Unsaturated:** has C=C, kinked tails → liquid (plant oils)
- › **Phospholipids:** hydrophilic head + hydrophobic tails → form membranes (Unit 2)
- › **Steroids:** cholesterol, hormones
- › ~2× the energy per gram vs carbs → long-term storage

✓ Exam move

Given an unknown molecule, ID the **class from its monomer/clues**, then tie its **structure to a function**. That link is where the points are.

Proteins, Nucleic Acids & FRQ Skills

Where Unit 1 points are won: shape decides function, base-pairing rules, and the answer structure graders reward.

PROTEIN STRUCTURE → FUNCTION

- 1° **Primary** — amino-acid **sequence** (peptide bonds). Dictates all higher levels.
- 2° **Secondary** — α -helices & β -pleated sheets from **backbone H-bonds**.
- 3° **Tertiary** — full 3-D shape from **R-group** interactions: H-bonds, ionic, hydrophobic, **disulfide bridges**.
- 4° **Quaternary** — multiple subunits (hemoglobin = 4 chains).

DENATURATION & ENZYMES

- › **Denaturation**: heat/pH break **weak** 2°/3°/4° interactions → unfolds → loses function. Usually **not** peptide bonds.
- › **Enzymes**: active-site **shape** fits substrate; off-optimal temp/pH distorts site → rate drops.

Model example — **sickle cell**: one amino-acid swap → altered R-group chemistry → hemoglobin clumps under low O_2 → cells sickle → impaired transport. One letter of 1° changes the phenotype.

NUCLEIC ACIDS • DNA VS RNA

Nucleotide = phosphate + 5-carbon sugar + nitrogenous base.

FEATURE	DNA	RNA
Sugar	Deoxyribose	Ribose
Strands	Double (helix)	Usually single
Bases	A, T, C, G	A, U , C, G
Job	Store info	Carry / use info

PAIRING & DIRECTIONALITY

- › **A-T** (A-U in RNA): 2 H-bonds • **C-G**: 3 H-bonds → more stable
- › **Antiparallel**: strands run 5'→3' opposite 3'→5'; new bases add to the **3' end**
- › Backbone = covalent phosphodiester; bases held by H-bonds

Worked complement: 5'-A C G T T A-3' pairs to 3'-T G C A A T-5'. Match A-T/C-G, then **flip direction** (the trap answer keeps direction).

+ Trap

RNA uses **U**, not T. And **C-G (3 H-bonds)** separates harder than A-T (2).

TOP 6 POINT-LOSERS

- › Cohesion vs adhesion (water-water vs water-surface)
- › Lipids are **not** polymers
- › RNA uses **U**, not T
- › Denaturation hits 2°/3°/4°, not peptide bonds
- › Dehydration **builds** ($-H_2O$); hydrolysis **breaks** ($+H_2O$)
- › C-G = 3 H-bonds (stronger) vs A-T = 2

THE C-E-R ANSWER FORMULA

- › **Claim** — answer in one clear sentence
 - › **Evidence** — cite the specific data / detail
 - › **Reasoning** — the **mechanism** linking them, in Unit-1 vocab
- Model**: enzyme loses activity after a mutation → **Claim**: active-site shape changed → **Evidence**: R-group interactions shifted → **Reasoning**: substrate no longer fits, so binding & catalysis fall.

✓ 7-day micro-plan

D1 water • D2 CHNOPS/carbon • D3 monomers & reactions • D4 macro table from blank • D5 proteins/enzymes • D6 DNA vs RNA • D7 mixed + 2 CER answers.